0611-L-02

I 49.77/5: B 38

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POINT ARENA MOUNTAIN BEAVER

Aplodontia rufa nigra (Rafinesque)

RECOVERY PLAN

Prepared by

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and

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for

Region 1

U.S. Fish and Wildlife Service

Portland, Oregon

October 1996

nk 98-027507

Acknowledgments

The following individuals contributed significant information/assistance during recovery plan preparation:

Dan Campbell
Jim Dines
Kim Fitts
Rickye Heffner
Mike Horton
Kevin Joe
Caryla Larson
Alan Levine
Darlene McGriff
Richard Meredith
Phil Northen
Renee Pascinelli
Bert Pfeiffer
Ron Schlorff
Brad Valentine
Alison Willy

Special acknowledgement for the pioneering *Aplodontia rufa nigra* research by C. Camp and E. Pfeiffer.

The cover drawing is used courtesy of the California Wildlife Habitat Relationships Program, California Department of Fish and Game, Wildlife Management Division from: D.C. Zeiner, W.F. Laudenslayer, Jr., K.E. Mayer, and M. White, eds. 1990. California's Wildlife, vol. III, mammals. California statewide wildlife habitat relationships system. State of California, The Resources Agency, Department of Fish and Game, Sacramento, California.

Executive Summary

Current Species Status: The Point Arena mountain beaver *(Aplodontia rufa nigra)* is a federally listed endangered species. This subspecies of mountain beaver is only known from a small area of coastal Mendocino County, California, where 24 apparently separate populations have been found, with an estimated 200–500 animals. Potential threats to the habitat of the species include elimination or degradation from land development, grazing, timber harvest, and invasion by alien plant species. Direct threats to the species may include predation by household pets and feral animals, poisoning, genetic isolation and genetic drift, and possible sensitivity to disturbance. Basic biological data is lacking to determine the level of vulnerability of the mountain beaver to each of these factors.

Habitat Requirements and Limiting Factors: *A. r. nigra* requires a cool moist environment. It lives in underground burrow systems under dense stands of perennial vegetation where soil conditions allow for easy excavation.

Recovery Objective: Delisting.

Recovery Criteria:
Population monitoring after a 12 year period shows a stable or increasing population size trend for a period of about 10 years. Habitat is secured to ensure protection of existing and future populations.

Actions Needed:

1. Protect known populations.
2. Protect potential habitat, buffers, and corridors.
3. Develop management guidelines.
4. Gather biological and ecological data.
5. Determine feasibility of , and need for, relocation.
7. Establish an outreach program.

Estimated Cost of Recovery: $955,500+*

Date of Recovery: Downlisting could be initiated in 2015 and delisting by 2025.

* *The total cost of this recovery effort could be higher than this figure. The costs for several tasks needed for recovery have yet to be determined.*

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I. Introduction

A. DESCRIPTION

The Point Arena mountain beaver *(Aplodontia rufa nigra)* was listed as a federally endangered species by the Fish and Wildlife Service (Service) on December 12, 1991 (50 *Federal Register* 64716). It is also listed as a highest priority "Species of Special Concern" by the State of California (Williams 1986).

The first published account of mountain beaver, *Aplodontia rufa* (Rafinesque), comes from the journals of Lewis and Clark in 1805 (Godin 1964). The Point Arena subspecies was originally described by Taylor (1914) as a separate species, *Aplodontia nigra,* because of its unique color and certain anatomical features. It was later revised to subspecies status, *Aplodontia rufa nigra,* due to overlap of characteristics with other subspecies and lack of representative specimens (Taylor 1918). This classification has been upheld through several revisions (Dalquest and Scheffer 1945, Hall and Kelson 1959, Hall 1981). A considerable degree of geographical and individual variation exists within subspecies of *Aplodontia* (Dalquest and Scheffer 1945). Isolation is probably a major factor in the speciation of the genus (Finley 1941).

The mountain beaver has been compared to an overgrown pocket gopher (Ingles 1965) and a muskrat without a tail (Racy 1922). Its body is stout, compact and cylindrical. An average adult measures slightly more than 30.5 centimeters (cm) (one foot (ft)) in length and weighs 0.8–1.8 kilograms (2-4 pounds) (Feldhamer and Rochelle 1982). The skull is relatively broad, massive, laterally compressed, and notable for its flat upper surface and lack of postorbital processes (spur of bone above the eye socket) (Hall 1981). Long, stiff whiskers (vibrissae) are present on the nose, and guard hairs are plentiful in the fur. A little patch of white hair occurs at the base of each ear. The eyes and ears are quite small. Limbs are short, the fore and hind limbs of about equal length. The forefeet have functionally opposed thumbs, and all digits have long, curved claws. A distinctive feature of its external anatomy is its cylindrical stump of a tail.

Several characteristics distinguish the Point Arena mountain beaver from other subspecies. The most obvious is its unique black coloration. The outline of the nasals is also distinctive, as are some cranial skull measurements (Taylor 1914). *A. r. nigra* is also the smallest of the Californian subspecies.

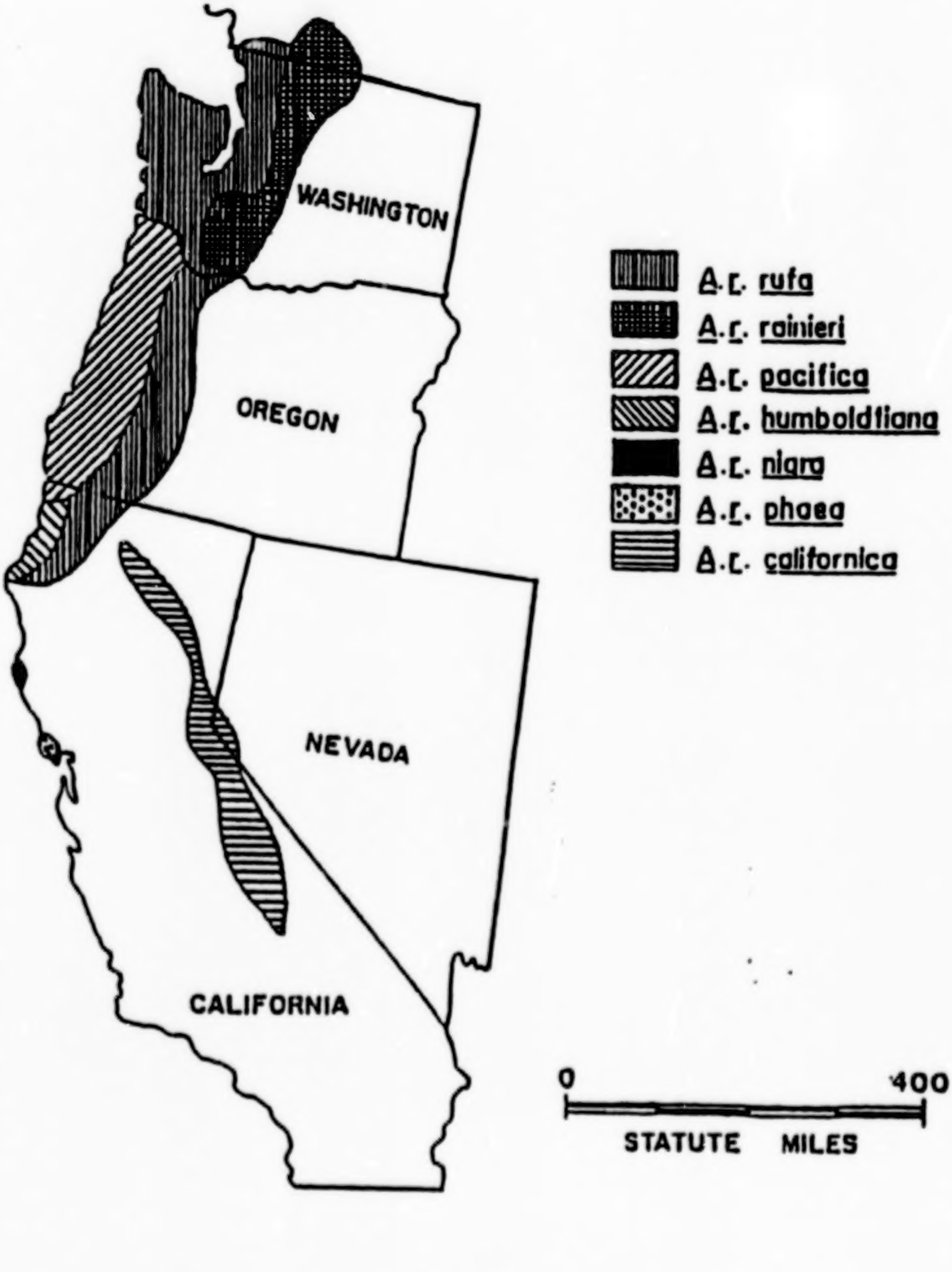
The mountain beaver, also known as sewellel, boomer, and many other names, is not closely related to true beavers *(Castor)*. *Aplodontia* are considered to be the oldest group of living rodents, being the sole extant member of the superfamily Aplodontoidea, which has been almost morphologically unchanged in the fossil record since the Miocene (Simpson 1945). This "living fossil" is thought to be ancestral to the squirrel family (Shotwell 1958).

B. GEOGRAPHICAL DISTRIBUTION

The Point Arena mountain beaver is known only from its type locality, an area of about 62 square kilometers (km) (24 square miles (mi)), entirely in western Mendocino County (Camp 1918). The seven subspecies of mountain beaver are found in cool, moist climates along the Pacific Coast of North America, from southern British Columbia to Point Reyes, California and east to the Cascade and Sierra Nevada Ranges (Scheffer 1929) (Figure 1). Three subspecies are found along the northern coast of California—the Humboldt mountain beaver *(Aplodontia rufa humboldtiana)*, the Point Reyes mountain beaver *(A. r. phaea)*, and the Point Arena mountain beaver *(A. r. nigra)*. These three subspecies are isolated by considerable distances (Steele 1986). *A. r. humboldtiana* is approximately 130 km (80 mi) north of the Point Arena mountain beaver and *A. r. phaea* is 100 km (60 mi) to the south. The length of time these populations have been isolated is not known.

Historical records of *A. r. nigra* are scarce (Table 1). Camp (1918) reported that "colonies" extend from the town of Point Arena to Alder Creek, 12 km (7.5 mi) to the north. This range was extended north another 7 km (4.5 mi) when animals were collected at Christianson Ranch in 1951 by Pfeiffer. Based on recent surveys, the current distribution of *A. r. nigra* appears roughly equivalent to that of earlier records. Populations have been found along Mill Creek, Mallo Pass Creek, Irish Creek, Alder Creek, Manchester State Beach, Lagoon Lake, Minor Hole Road, and Point Arena

Figure 1. Distribution of known *Aplodontia rufa* subspecies



Distribution of the seven subspecies of mountain beaver (modified from Godin 1964). Note that three of the four California endemic subspecies have isolated distributions. (Technically, the Sierra Nevada mountain beaver is not endemic to California as it has been collected within the Nevada portion of the Tahoe Basin.)

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Table 1. Museum specimens of the Point Arena mountain beaver

Collector	Date	Location	Sex	Age	Weight (grams)	Length (millimeters)	Skin	Skull	Skeleton	Museum	Comments
C.L. Camp	7-9-13	Point Arena or Alder Creek	Male	Unknown	Unknown	310 mm	X	X	Complete	University of California at Berkeley, Museum of Vertebrate Zoology	Type specimen.
C.L. Camp	7-9-13	Point Arena or Alder Creek	Male	Unknown	908 g	316 mm	X	X	Partial	University of California at Berkeley, Museum of Vertebrate Zoology	
C.L. Camp	7-9-13	Point Arena or Alder Creek	Unknown	Unknown	Unknown	Unknown				University of California at Berkeley, Museum of Vertebrate Zoology	Foot only
C.L. Camp	7-10-13	Point Arena or Alder Creek	Unknown	Unknown	Unknown	Unknown	X	X	Partial	University of California at Berkeley, Museum of Vertebrate Zoology	Type specimen
C.L. Camp	7-11-13	Point Arena or Alder Creek	Male	Unknown	909 g	325 mm	X	X	Complete	University of California at Berkeley, Museum of Vertebrate Zoology	Type specimen
T. Storer	7-13-31	Alder Creek	Female	Unknown	Unknown	328 mm				University of California at Berkeley, Museum of Vertebrate Zoology	
D.H. Johnson *et. al*	12-32	Unknown	Unknown	Unknown	Unknown	Unknown		X	None	University of California at Berkeley, Museum of Vertebrate Zoology	
W.E. and F. Wood	3-4-34	Point Arena	Male	Adult	Unknown	316 mm	X	X	X	Carnegie Museum of Natural History	Age based on curator evaluation of tooth eruption and fusion of skull sutures
W.E. and F. Wood	8-23-39	Point Arena	Female	SubAdult	Unknown	306 mm	X	X	X	Carnegie Museum of Natural History	Age based on curator evaluation of tooth eruption and fusion of skull sutures
W.E. and F. Wood	8-23-39	Point Arena	Female	Adult	Unknown	306 mm				Carnegie Museum of Natural History	Age based on curator evaluation of tooth eruption and fusion of skull sutures
E.W. Pfeiffer	4-3-51	Christensen Ranch (near Bridgeport Landing)	Female	Unknown	1069 g	307 mm	X	X	None	University of California at Berkeley, Museum of Vertebrate Zoology	Reproductive research
E.W. Pfeiffer	11-25-51	Christensen Ranch	Female	Unknown	1045 g	333 mm	X	X	None	University of California at Berkeley, Museum of Vertebrate Zoology	Reproductive research
B. Jones	4-89	2 miles east of Point Arena	Female	Unknown	Unknown	Unknown	X	X	Complete	University of California at Berkeley, Museum of Vertebrate Zoology	Tissue collected and preserved
B. Jones	8-89	Point Arena (Kinney Road at Manchester State Park)	Female	Unknown	Unknown	Unknown	X	X	Complete	University of California at Berkeley, Museum of Vertebrate Zoology	Tissue collected and preserved

NOTES: Data results from contacting more than 50 museums and universities and reviewing data on over 1,000 mountain beaver specimens.

(Figure 2). Twenty-four apparently separate populations are known (Table 2). The size of the total population is estimated to be 200-500 animals (Steele, Wooster, unpublished data). The most recently discovered population occurs south of the Garcia River, to the east of the Manchester-Point Arena Rancheria (Figure 2), where it was located in the spring of 1996 (Alan Mohr and Associates, Inc., pers. comm. 1996).

C. HABITAT

Mountain beaver live in underground burrow systems with openings under dense stands of vegetation (Scheffer 1929), often on steep north-facing slopes or in gullies (Steele 1986). The burrows are found in moist areas with well-drained soil (Ingles 1965).

Mountain beaver require large amounts of lush vegetation for survival (Voth 1968). Distribution limits are associated with rainfall and soil conditions that promote lush vegetation and high humidity within burrows (Voth 1968). Studies suggest that the most important factors in habitat use are a cool thermal regime, adequate soil drainage, abundant food supply (Beier 1989), a high percent cover of small diameter woody material, and soft soil (Hacker and Coblentz 1993).

Populations of the Point Arena mountain beaver are found in coastal scrub, coastal strand, conifer forest, and riparian plant communities (Steele 1986). The vegetation at the Point Arena, Minor Hole Road, Lagoon Lake, Alder Creek, and Mallo Pass Creek

Figure 2. Known Point Arena mountain beaver populations

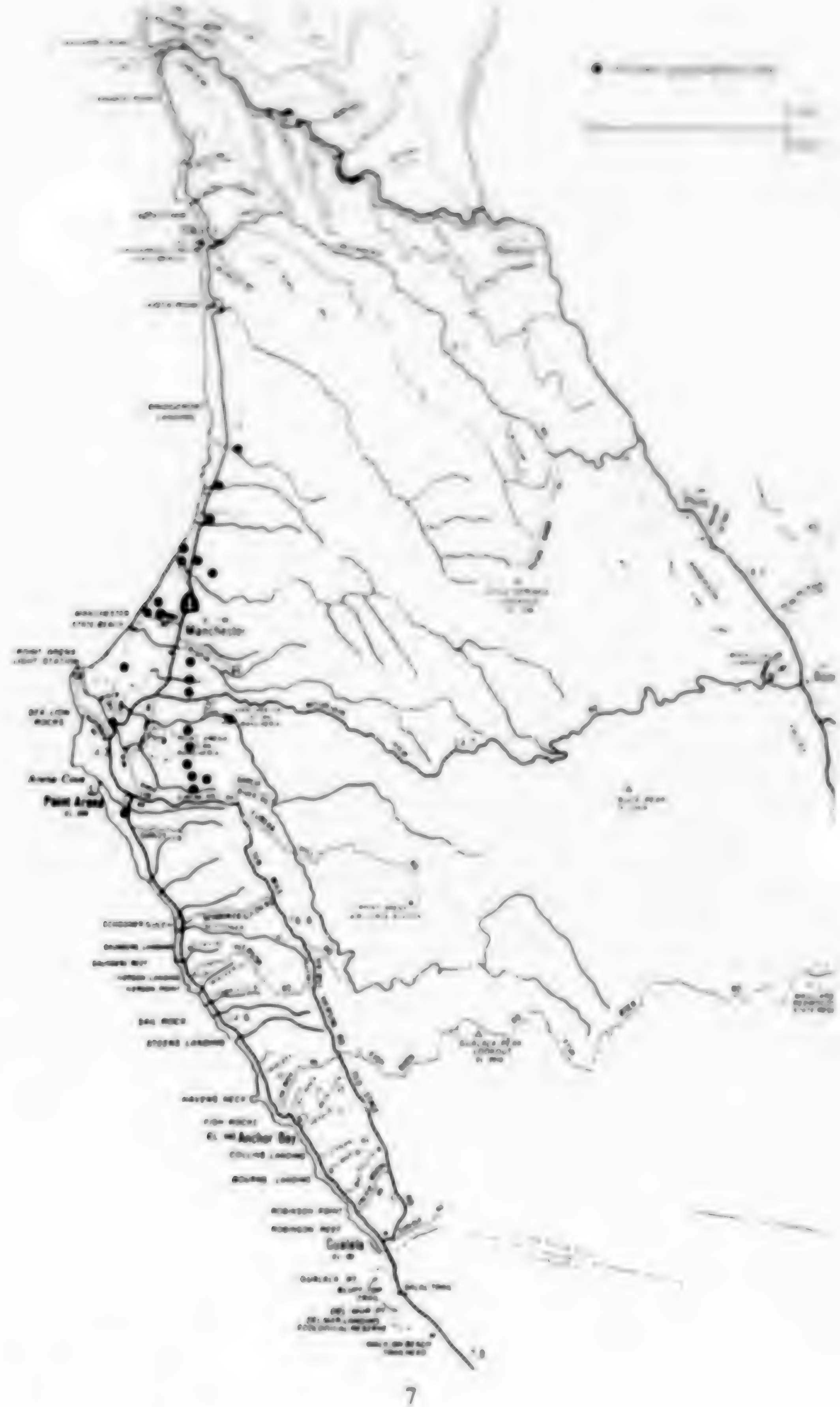

Table 2. Known populations of the Point Arena mountain beaver

Site	Area (ha)	# Burrows	Habitat Type[1]	Potential Threats	Ownership	Estimator	Year	Comments
Point Arena Creek	1.50	30	CS	Grazing, Herbicides, Feral Pets, Roads	City of Pt. Arena, Private	Steele	1986	Dog killed PAMB
Minor Hole Road	1.00	43	CS, R	Feral Pets, Roads, Grazing	Private	Steele	1986	
Lagoon Lake	0.75	25	CS	Feral Pets, Fire, Trails	CDPR[2]	Steele	1986	Recent Fire
AT&T Facility	1.50	250+	CS, CSt	Construction, Human Access, Operation & Maintenance, Storm Damage	CDPR, Private	Steele, Fitts[3]	1989, 1994	MCI Monitoring
Manchester Beach	0.75	18	CS, CSt	Campground, Feral Pets, Roads, Trails	CDPR	Steele, Fitts	1989, 1994	Pedestrian Impacts
Davis Pond	0.50	40	CS, CSt	Human Access	CDPR	Steele	1989	Skull Found
Alder Creek	2.00	100+	CS, R	Grazing, Roads, Herbicides, Foot Traffic	CDPR, Private	Steele, Fitts	1986, 1994	Fault Area
Irish Creek	1.50	50	R, C	Housing Development, Feral Pets, Roads, Trails	Private	Steele	1986	
Mallo Pass Creek	1.50	55+	CS, ferns	Water Diversion, Roads, Fire	Private	Steele	1986	
Brush Creek	2.90	NA[4]	R	Pets, Herbicides, Streambed Disturbance	Private	Steele[5]	1992	
Lagoon Creek Trib. #1	5.90	NA	CS	Grazing, Utility Corridor, Fire	Private	Steele	1992	
Lagoon Creek Trib. #2	2.20	NA	CS	Grazing, Utility Corridor, Fire	Private	Steele	1992	
Garcia River Tributary #1	5.50	NA	R	Grazing, Fire	Private	Steele	1992	Drilling Disturbance
Garcia River Tributary #2	2.30	NA	CS, R	Grazing, Fire	Private?	Steele	1992	
Garcia River Tributary #3	2.00	NA	CS, R	Grazing, Fire	Private	Steele	1992	
Garcia River	0.03	36+	R	Fire, grazing, human access, floods	Private	Mohr	1996	
Hathaway Creek N. #1.	7.00	NA	R, CS	Grazing, Fire	Private	Steele	1992	
Hathaway Creek S	0.30	NA	CS	Grazing, Fire	Private	Steele	1992	
Hathaway Creek N. #2	0.30	22	R, CS	Grazing, Fire	Private	Wooster[6]	1993	Two small sites
Alder Creek N. Bluff	0.50	NA	CS	Grazing?, Fire	CDPR	Wooster	1992	"Riddled with burrows"
Mill Creek	0.02	20+	Nettles, Herbs	Grazing, Fire, Timber Harvest	Private	Wooster	1992	
Owl Creek	0.05	NA	NA	Grazing Timber Harvest, Fire	Private	Wooster	1992	Two small sites
Wildcat Creek	0.13	74+	Alder, ferns	Grazing Timber Harvest, Fire	Private	Wooster	1992	Three small sites
Levine Property	0.05	10+	CS	Grazing?, Fire	Private	Steele	1994	Possible Easement

CS=Coastal Scrub, R=Riparian, CSt=Coastal Strand, C=Coniferous; [2] California Department of Parks and Recreation; [3] Fitts, unpubl. data (1994) ; 4 Not Available [5] Steele, unpubl. data (1992); [6] Wooster, unpubl. data (1992, 1993) sites is coastal scrub. Common coastal scrub species include cow parsnip *(Heracleum lanatum)*, coyote brush *(Baccharis pilularis)*, wax myrtle *(Myrica californica)*, California blackberry *(Rubus ursinus)*, salmonberry *(R. spectabilis)*, and thimbleberry (*R. parviflorus*). Steep terrain and dense thickets make this habitat almost impenetrable for larger animal species. Riparian vegetation is present at several population locations. Common species include skunk cabbage *(Lysichitum americanum)*, horsetail *(Equisetum telmateia)*, willows *(Salix lasiolepis* and *S. sitchensis)*, red alder *(Alnus rubra)*, wood rose *(Rosa gymnocarpa)*, and California blackberry. The Irish Creek population site has a conifer overstory with Douglas-fir *(Pseudotsuga menziesii)*, grand fir *(Abies grandis)*, and bishop pine *(Pinus muricata)*. The understory includes elements of both riparian and coastal scrub habitats, including thimbleberry, stinging nettle *(Urtica* sp.*)*, sword fern *(Polystichum munitum)*, salmonberry, and elderberry *(Sambucus* sp.*)*.

Three mountain beaver populations at Manchester State Beach occupy a habitat type that differs from that of other populations (Steele 1986). These populations are found in stabilized dunes dominated by bush lupine *(Lupinus arboreus)* and other coastal strand species including coyote brush, coast goldenrod *(Solidago spathulata)*, dune grasses, and ice plant *(Carpobrotus* sp.*)*. The soil on these dunes is more stabilized and compacted than that found on open dunes, there is substantially more ground cover, and burrow openings are found under shrubs. These sites offer less cover, fewer food plants, and poorer burrowing conditions than other *A. r. nigra* sites, but these small populations appear to have remained stable over 10 years of observation (Steele, pers. obs.).

The most recently discovered population, on the south side of the Garcia River, is about 15 m (50 ft) from the river, between a riparian zone dominated by red alder and California laurel (*Umbellularia californica*), and a hillslope forested with redwood (*Sequoia sempervirens*) and grand fir. The colony area is covered by a dense, 1.0-1.2 m (3-4 ft) high vegetation dominated by cow parsnip, stinging nettle, horsetail (*Equisetum arvense*), and California blackberry. Shrubs of cascara (*Rhamnus purshiana*) and coyote brush surround the site on all but the north side (A. Mohr, pers. comm. 1996).

Large areas of seemingly suitable habitat are unoccupied by mountain beaver. Camp (1918) noted that (in observations of the Point Reyes mountain beaver) "overcrowded conditions may prevail in one place, while territory of the same character remains unoccupied nearby."

Other rare animal and plant species may occur in the vicinity of Point Arena mountain beaver habitat. These include the foothill yellow-legged frog *(Rana boylei)*, tidewater goby *(Eucyclogobius newberryi)*, swamp harebell *(Campanula californica)*, and Mendocino Coast Indian paintbrush *(Castilleja mendocinensis)*.

D. LIFE HISTORY/BIOLOGY/ECOLOGY

Little research has been done on the Point Arena mountain beaver.. The only historical records available are from Taylor (1914 and 1918), who first described the subspecies;

Camp (1918), who made some natural history observations; and Pfeiffer, who in 1951 captured two animals for reproduction studies (Table 3). Some basic surveying and monitoring have been done since 1982. Most studies have been conducted on the more abundant subspecies of *Aplodontia rufa,* primarily those in Oregon and Washington. Nevertheless, knowledge of the biology and ecology of the genus is limited and often based solely on anecdotal records. Given its ancient lineage, unusual physiological characteristics, unique food niche and fascinating behavior, this amazing animal could provide insights in a variety of fields.

Table 3. Chronology of research on the Point Arena mountain beaver

Author	Reference	Year	Comments
Taylor, W.	A previously undescribed *Aplodontia* from the middle north coast of California. University of California Publications in Zoology 12:297-300	1914	Taxonomy
Camp, C.	Excavations of burrows of the rodent *Aplodontia* with observations on the habits of the animal. University of California Publication in Zoology 17(18):517-535.	1918	Natural history observations, specimens collected
Pfeiffer, E.	The reproductive cycle of the female mountain beaver. Journal of Mammalogy 39(2):223-235.	1958	Reproduction, specimens collected
Steele, D.	An Ecological Survey of Mountain Beaver (*Aplodontia rufa*) in California. Non-game Wildlife Investigations, Job IV-16.1, California Department of Fish and Game	1982	Preliminary survey based on museum records
Steele, D.	A Review of the Population Status of the Point Arena Mountain Beaver (*Aplodontia rufa nigra*). Final Report No. 10188-5671-5, U.S. Fish and Wildlife Service, Sacramento Endangered Species Office.	1986	Population surveys
Steele, D.	An Ecological Survey of the Mountain Beaver (*Aplodontia rufa*) in California, 1970-83. Wildlife Management Division Administrative Report No. 89-1.	1989	Revision of 1982 report
Northen, P. and K. Fitts	Monitoring of the Point Arena mountain beaver for MCI Telecommunications Corp.	1993-1996	5-year mitigation monitoring (in progress)

Burrows

Mountain beaver are seldom seen, being most often identified by extensive underground burrow systems that have numerous openings to the outside (Taylor 1914, Camp 1918). These openings are approximately 15 cm (6 inches (in)) in diameter and occur every few feet (Racy 1922). Burrows are usually in moderately firm soil where digging is easy, but mountain beaver have been known to dig in other soil types, even sticky clay (Hubbard 1922). Tunnels generally run within 0.3 meters (m) (1 ft) of the surface, but sometimes descend to depths of 1-1.5 m (3–5 ft) (Racy 1922, Martin 1971). Burrow systems vary in size. Camp (1918) reported a burrow system of *A. r. phaea* that extended for more than 100 m (330 ft) in one direction. The burrow territory of a single animal, however, probably does not exceed 25 m (80 ft) (Voth 1968). Burrow excavations have shown that mountain beaver burrows contain narrow tunnels (Ingles 1965) that seem to be related to animal size, so that the whiskers can reach both sides (Voth 1968). Tunnels meander with no apparent plan (Scheffer 1929). The direction, extent, and placement of runways and openings is determined by external factors such as obstructions, soil composition, bank slope, etc. (Scheffer 1929). Burrow openings may be used for entrance and exit, for pushing out excavated earth or debris, or may result from erosion or cave-ins (Scheffer 1929). Burrow activity decreases in the winter (Scheffer 1929).

Mountain beaver are not colonial animals and exhibit little social interaction (Scheffer 1929). The burrows of several animals are often connected, which led early investigators to misname them "colonies" (Camp 1918), a misconception that continues to create confusion. References to the colonial nature of the animals are found even in recent literature (Huffman 1993). Mountain beaver exhibit a "contagious distribution," that is, the presence of one or more animals in a given area seems to encourage the settlement of others (Goslow 1964). However, they are solitary animals, except during a short breeding period (Godin 1964).

There are no hard data available on the population density of the Point Arena mountain beaver. Population estimates are crude, and have been based on observations and conservative counts of approximately 5–10 burrow openings per animal. The burrow openings that honeycomb the ground may appear to indicate a large population, but this is probably not the case. Population density is difficult to determine, because several animals may share the same contiguous burrow system with each individual's portion having many openings to the outside. Camp (1918) found a total of 11 *A. r. phaea* in a burrow system measuring 30 by 152 m (100 x 500 ft), with over 100 burrow entrances. Population estimates have ranged from 0.61–0.81 individuals per hectare (ha) (1.5–2 /acre (ac)) in studies of *A. r. rufa* and *A. r. pacifica*, respectively (Neal and Borrecco 1981, Lovejoy and Black 1979), to 3.6–4 individuals per ha (9–10/ac) in a study of *A. r. phaea* (Camp 1918). Temporarily high densities have been estimated at 6.5/ha (16/ac) in studies of *A. r. pacifica* (Voth 1968).

Nest

There are five types of underground chambers within mountain beaver burrows—nest, food, refuge, fecal pellet, and earth ball storage (Voth 1968). The nest is an enlarged chamber, often 50–60 cm (20-25 in) in diameter and 36 cm (14 in) high, and is usually deeper than other parts of the burrow (Voth 1968). Nests used by adults may contain as much as 0.3 m^3 (1.2 ft^3) of vegetative material, while subadult nests contain less (Martin 1971). Voth (1968) found differences between the nests of males and females, both in nesting material and the fact that female nests had fewer parasites. Nests are constructed of two shells—an outer shell of coarse vegetation and an inner shell with soft, dry vegetation (Martin 1971). Only one animal lives in a nest (Hubbard 1922, Martin 1971).

Mountain beaver spend about 75 percent of their time in the nest chamber (Ingles 1959, Kinney 1971). The burrow system and nest chamber offer a cool, moist refuge in the summer and a warm and protected environment during the winter (Johnson 1971).

Burrows also contain earth ball storage chambers in which "mountain beaver baseballs" are stored (Voth 1968). These "baseballs" are rocks or lumps of hard clay encountered while digging. They usually weigh about 80–200 grams (3-7 ounces). They may be used for two purposes: 1) to close nest-feeding chambers during the animal's absence, and 2) to provide abrasive material to trim their incisors (Camp 1918, Voth 1968).

Burrow Community

Mountain beaver burrow systems support a community of vertebrates and other animals (Scheffer 1945). Skunks, salamanders, moles, voles, shrews, chipmunks, ground squirrels, mice, woodrats, gophers, weasels, mink, hares and brush rabbits have all been recovered from mountain beaver burrows (Pfeiffer 1953, Voth 1968, Whitaker *et al.* 1979, Maser *et al.* 1981). These animals may have been present as commensals, predators, or by accident.

A unique invertebrate fauna also associates with mountain beaver. Perhaps the most striking example is *Hystricopsylla schefferi*, the largest flea in the world, which grows to 9 mm (0.5 in) in length (Scheffer 1929). An invertebrate community also lives in the fecal pellet chambers and aids in decomposition (Voth 1968). Several species of host-specific mites are associated with mountain beaver (Whitaker *et al.* 1979). Other parasites include ticks and tapeworms (Canaris and Bowers 1992). Neither lice (Scheffer 1969) nor nematodes (Canaris and Bowers 1992) have been identified from mountain beaver. The parasite community of the Point Arena mountain beaver has not been investigated, but given the primitive nature of *Aplodontia rufa*, its relationship with this unique fauna inspires many evolutionary questions.

Cleanliness

Mountain beaver are fastidious creatures (Wright 1969), that keep their tunnels clean and free of debris (E. Ingles 1960). Special blind tunnels are used as refuse and fecal chambers (Martin 1971). Unused portions of vegetation are placed with other discarded materials in the refuse chamber (Voth 1968) or pushed out of burrow openings (Steele, pers. obs).

Defecation is accomplished in a precise manner in which the animals takes each fecal pellet in its mouth as it is extruded from the anus and tosses it with a flip of its head into the fecal pile (Kindschy and Larrison 1961). This is done for 2 to 5 minutes at a time. An average of 40 to 160 pellets during a 24-hour period is produced in the field (Voth 1968). One out of every 10 to 13 pellets is reingested directly as it is expelled (Ingles 1961). These special pellets are soft, green and larger than the brown, hard pellets which are discarded. The function of this coprophagy is not known, but it may allow maximum use of nutrients and vitamins contained in the food (Ingles 1961). A number of other rodents, as well as rabbits and hares, also form a special kind of feces from the contents of the caecum (the blind pouch which forms the beginning of the large intestine) which is reingested directly from the anus (Schmidt-Nielsen 1975). Studies have shown that coprophagy in these other animals has great nutritional importance, providing vitamins, and increasing digestibility, protein utilization, and nitrogen retention.

Foraging

Mountain beaver are strict herbivores (Ingles 1965). They are known to eat a wide range of plant species, which often includes just about all the species within reach of the burrows (Camp 1918, Scheffer 1929). Herbaceous plants are eaten whole, while woody plants are discarded after the bark has been peeled off for food (Scheffer 1929). Clipped vegetation can often be observed near burrow systems (Steele, pers. obs.).

Mountain beaver are voracious eaters (E. Ingles 1960). Studies have shown that 73 percent of their active time is spent gathering, handling and eating food (Ingles 1959). They seldom venture far from their burrows, which may open directly into suitable vegetation (Camp 1918, Martin 1971). The animals forage for short distances above ground and then carry or drag the cut vegetative material, which may vary in length from a few inches to several feet, to the burrow (Scheffer 1929). There, the material is cut into short sections at the burrow entrance and carried into the burrow to be eaten or stored (Scheffer 1929, Martin 1971). Animals may eat vegetation outside of the burrow, but most often consume it in feeding chambers, adjacent to the nest (Martin 1971).

While mountain beaver gather many of the plants in their vicinity, there appears to be a decided preference for certain types of plants (Camp 1918, Voth 1968, Allen 1969), including shrubs and smaller trees (Crouch 1968). The coastal mountain beaver subspecies are predominantly fern and root eaters (Camp 1918). Some of their preferred foods include plants that are unpalatable or toxic to other mammals such as bracken fern (*Pteridium aquilinum*), sword fern, stinging nettles, thistles (*Cirsium* spp.), corn lily (*Veratum* sp.), salal (*Gaultheria shallon*), foxglove (*Digitalis purpurea*), larkspur (*Delphinium* sp.), and skunk cabbage (Voth 1968, Lacy 1991). This gives the mountain beaver a largely uncontested food niche (Johnson 1971). This ability to consume plants with such a variety of toxic secondary compounds is unusual and may involve a metabolic "cost" to the animal (Lacy 1991).

Voth (1968) found that mountain beaver cut and store about 2.5 times more food than they eat. However, through part of the winter season or during the full moon much less is harvested than is eaten, suggesting storage facilities for as much as a two-week supply of forage. Storage locations are numerous, including outside caches, covered caches, and food chamber caches (Voth 1968).

Many observers have described a behavior called "haystacking," in which mountain beaver cut bundles of plants and lay them on logs or on the ground to wilt (Camp 1918, Godin 1964, Voth 1968). Haystacking has generally been assumed to provide dried vegetation for nesting or food storage (Scheffer 1929). Voth (1968), however, suggests that the purpose of haystacking is to regulate the moisture content of the food by mixing wilted with fresh vegetation.

Activity

Aplodontia are mostly nocturnal animals but they are often seen in the daytime (Ingles 1959, Wright 1969). During a study by Ingles (1959), mountain beaver exhibited 6–7 activity periods in a 24-hour period, with a total of 8–9 active hours and 15–16 hours of rest. The longest rest period was in the daytime (4.25 hours) and the longest activity period (2.75 hours) at night. This study showed that *Aplodontia* may be active outside its burrow at any hour, but is 50–60 percent more active at night (Ingles 1959).

Bright sunlight appears to make *Aplodontia* drowsy (Godin 1964). Mountain beaver have been observed to stop while foraging or even in mid-flight, nod, and then fall asleep in open, unprotected areas. This seemingly nonadaptive "narcolepsy" may be a reaction to bright light, warmth, panic or other conditions (Goslow 1964, Steele, pers. obs.).

Mountain beaver do not hibernate (Scheffer 1929). They remain active during the winter (Hall and Kelson 1959, Ingles 1965), although activity decreases then (Voth 1968).

Data from radiotelemetry studies on animals in Washington showed that mountain beaver 90 percent of the animals remain within 24 m (80 ft) of their nest site (Martin 1971). The average home range (the above-ground area in which the animal forages) varies depending on habitat and has been reported as 0.08–0.16 ha (0.2–0.4 ac) with no apparent difference in mean ranges of males and females (Martin 1971, Neal and

Borrecco 1981). A scrotal male moved 197 m (350 ft) from his nest as compared to a maximum movement of 49 m (160 ft) for all other animals studied (Martin 1971). Mountain beaver walk with a wide, shuffling gait, "like a bear" (Fisler 1965). They can run backwards as quickly as forward, an obvious advantage for narrow tunnel living (Camp 1918, Steele, pers. obs.). They can also climb trees (Ingles 1960), sometimes to a height of 4.6 m (15 ft) (Herlocker 1950).

While not aquatic animals, mountain beaver do not avoid water. Often, surface water is diverted down their burrows (Herlocker 1950), and they wade through partially flooded tunnels going about business as usual (Scheffer 1929). They traverse puddles and streams and can swim (Scheffer 1929, E. Ingles 1960). When free water is available, mountain beaver bathe regularly while digging or foraging (Goslow 1964).

Thermoregulation

One explanation for the limited distribution range of mountain beaver is their limited ability to thermoregulate (*i.e.*, regulate body temperature) (Johnson 1971, Kinney 1971). They seem to tolerate low temperature extremes better than high ones, with a lethal body temperature of about 42°Centigrade © (108°Fahrenheit (F)) (Johnson 1971). When exposed to high ambient temperatures, animals in captivity respond by either reducing their activity and changing their body conformation (sprawling out their body), or by attempting to escape (Kinney 1971). Mountain beaver lack such behavioral responses as panting or salivation to reduce heat stress (Johnson 1971) and do not sweat. An annual summer molt decreases insulation, letting them tolerate greater heat (Johnson 1971).

Burrows provide a highly stable microclimate (Kinney 1971). Tunnels, and especially the nest chamber, which is lower in elevation and insulated with nesting material, maintain a stable temperature gradient (Kinney 1971). Daily temperature variation never exceeds 4°C (7°F), and the mean annual range is from 2-14°C (36-57° F) (Johnson 1971). The burrow maintains a relative humidity of nearly 100 percent (Voth 1968).

The Point Arena area has a relatively mild climate due to the buffering effect of the ocean. Little range in temperature occurs either daily or annually, with average temperatures between 7.0–16.2°C (45-61°F). Point Arena has one of the longest growing seasons in California, over 300 days annually (Steele 1989).

Osmoregulation (Water Balance)

The mountain beaver has a very simple kidney structure, that lacks the anatomical features necessary to concentrate urine effectively (Pfeiffer *et al.* 1960, Schmidt-Nielson and Pfeiffer 1970). It has been suggested that *Aplodontia* might have been one of the first mammals to have a renal mechanism for concentrating its urine (Dicker and Eggleton 1964). One consequence of this inability to concentrate urine is that mountain beaver require large quantities of water to replace that lost through excretion (Nungesser *et al.* 1960, Dolph *et al.* 1962, Nungesser and Pfeiffer 1965), a need that may be a major reason that mountain beaver are restricted to moist environments (Pfeiffer 1965). Mountain beaver consume about 33 percent of their body weight in water daily and excrete most of this in urine (Nungesser and Pfeiffer 1961). Animals in captivity are known to drink a great deal of free water (Pfeiffer 1953, Schmidt-Nielson and Pfeiffer 1970). If free water is withheld, animals in captivity *(A. r. pacifica)* have survived for periods of several months without apparent distress, obtaining water entirely from the succulent vegetation they consume (Fisler 1965, Johnson 1971). The long term "cost" to the animal, if any, of not having free water, is not known.

The importance of free water for Point Arena mountain beaver is not known. Some populations seem to live a considerable distance from free water. The marine climate around Point Arena includes significant amounts of moisture from fog. Condensation of fog may provide more free water than is apparent from stream locations.

Behavior

Mountain beaver can be aggressive animals and have been called "cantankerous" or "vicious" (Smurthwaite 1986) and are swift, strong biters (Maser *et al.* 1981). However, captive animals have been reported to become quite docile and even eat out of people's hands (Davis 1941, Herlocker 1950), although they do not exhibit affection or friendliness (Herlocker 1950, Smurthwaite 1986).

Territorial behavior is strong in mountain beaver (Nolte *et al.* 1993). Pfeiffer (1953) reports that males will kill females or other males if they are placed together in the same cage. Battles are common when animals encounter one another (Herlocker 1950). Although nests are defended fiercely, it is thought that tunnels are used in common by animals in a burrow system (Scheffer 1929). The response to meeting in a tunnel is unknown. Animals may forage in the same home range and meet with no apparent territorial response (Martin 1971). The fact that they tend to live in close association suggests some level of tolerance, perhaps based on chemical cues.

Mountain beaver have two scent glands at the base of their tail (Racy 1922). These give the animals a strong body odor, and may be a primary means of recognizing their own kind (Scheffer 1929). A sweet, musky smell in the urine is distinctive (Kindschy and Larrison 1961), and becomes accentuated during the breeding season (Fisler 1965). Scent-marking behavior has been observed (Nolte *et al.* 1993).

Mountain beaver produce large amounts of a milky eye secretion, which can at times cause their eyes to close. This secretion may be an indication of stress in captive animals (Steele, pers. obs.), or a defense against eye damage while excavating (Maser *et al.* 1981). It has also been suggested that the eye secretion may induce a tonic immobility to avoid attack or may function in chemical communication (Nolte *et al.* 1993).

Senses

As is true of many burrowing animals, mountain beaver have highly developed tactile senses and will respond quickly to the slightest disturbance of their guard hairs or whiskers (vibrissae) (Camp 1918, Scheffer 1929). Their senses of smell and taste also seem to be well developed. They will frequently raise their noses to sniff the air (Camp 1918, Voth 1968), and feeding is reduced when food is exposed to predator odors (Epple *et al.* 1993) or other repellent material (Campbell and Evans 1989). Their eyesight is poor and animals will frequently bump into objects in their path (Fisler 1965). Night vision is better than day vision (Voth 1968).

Although mountain beaver show little response to sharp noises (Fisler 1965), little is actually known about their auditory acuity. The possibility that mountain beaver can detect low or even very low frequencies is under investigation (R. Heffner, University of Toledo, pers. comm.). *Aplodontia* also has a very large and unique cochlear nuclear complex in the brain, which may indicate the ability to detect subtle changes in air pressure, perhaps an adaptation to burrow living (Merzenich *et al.* 1973).

Several types of vocalizations have been attributed to mountain beaver, including grunts, growls, cough-like sounds, sharp, high pitched coughs (Fisler 1965), and a harsh chattering-grating sound produced by gnashing the teeth (Maser *et al.* 1981). Scheffer (1929) states that mountain beaver do not whistle, but Kindschy and Larrison (1961) reported a shrill, whistle-like squeal from their captive animal. Mountain beaver do not make booming noises, as erroneously believed by early observers (Scheffer 1929).

Reproduction

Mountain beaver have an unusually low reproductive rate for a rodent (Pfeiffer 1958). Females typically do not breed until their second year (Pfeiffer 1958), and the breeding season is short and well-defined (Lovejoy and Black 1979). Females are monestrous, that is, they produce only one litter a year, and all breeding females ovulate at about the same time (Pfeiffer 1958). Gestation period is 28–30 days (Scheffer 1929, Pfeiffer 1958). Litters consist of two, three, or rarely four (Scheffer 1929, Dalquest 1948) or five (Herlocker 1950, Maser *et al.* 1981) offspring.

Newborn *Aplodontia* are naked and blind at birth (Cramblet and Ridenhour 1956, Lovejoy *et al.* 1978). Growth is rapid, and within 2 weeks newborns are completely covered with hair (Lovejoy and Black 1974). Lactation extends for about 2 months (Pfeiffer 1958, Lovejoy and Black 1974). Pregnant and lactating females have a dark patch of mammary hairs around the nipples, which may be a physiological relict lost by more advanced mammals (Pfeiffer 1955).

Juveniles have fine, gray fur, but within a year most have a coarse pelage and are difficult to distinguish from adults (Lovejoy and Black 1974). Pfeiffer (1958) identified four age classes, based on the degree of closure of the epiphyseal femoral suture and tooth wear. Voth (1968) identified eight classes based on weight. Lovejoy and Black (1979) worked with three age groups based on both weight and external characteristics and questioned the validity of weight classes. Mountain beaver are thought to live at least 5–6 years (Lovejoy and Black 1979).

Male and female *Aplodontia* are not easily distinguished by external characteristics (Scheffer 1929, Steele, pers. obs.), although Godin (1964) states that it is easy to distinguish male and female genitalia. Females are on average slightly smaller (Lovejoy and Black 1974), but not enough to be a diagnostic difference. During the breeding season the sexes of adults can be distinguished because the testes, which are normally abdominal, become semiscrotal (Pfeiffer 1956, Lovejoy *et al.* 1978). Pregnant and lactating females can be identified by the dark hair around the nipples (Pfeiffer 1955).

The sex ratio of juvenile *Aplodontia* is 1:1 (Lovejoy and Black 1979). However, trapping results of adult animals have indicated a skewed sex ratio of 3:1 favoring males (Hubbard 1922). Other trapping studies have also shown a preponderance of males, at levels of 63.6 percent (Voth 1968), and 61.9 percent (Lovejoy and Black 1979). This may be a true representation of the population and not an artifact of trapping (Lovejoy and Black 1974), but no explanation has been given for this phenomenon.

No data are available on the reproduction of Point Arena mountain beaver. The breeding season is thought to be from about mid-December to early January, based on data collected by Pfeiffer (1958) on *Aplodontia rufa phaea,* the Point Reyes mountain beaver. Gestation would then be from about mid- to late-January, and animals born in late January might begin to forage for themselves by early April. Size of litters, survival of young, sex ratio and other demographic information are unknown for subspecies nigra.

Dispersal of juvenile *Aplodontia* is thought to be primarily through excavation within the burrow system (Blair 1953), although some overland migration is seen (Martin 1971). Of 11 subadult animals monitored through radiotelemetry, nine remained near the initial site of capture while one moved as far as 564 m (1,850 ft). There seems to be no real difference between the movement of males and females (Martin 1971).

Dispersing animals may make several attempts to establish a nest before finding a suitable situation (Lovejoy and Black 1979, Martin 1971). Once the animal establishes its nest site, it continues to use it for long periods of time (Martin 1971). Animals may move quickly into an unoccupied nest (Martin 1971, Nolte *et al.* 1993)

Mortality

Mortality factors are not easily studied in underground species. Mountain beaver are known to be prey of bobcats *(Lynx rufus*), fishers (*Martes pennanti*), coyotes (*Canis latrans*), great horned owls (*Bubo virginianus*) (Ingles 1965), striped skunks *(Mephitis*

mephitis), eagles (Accipitridae family), minks (*Mustela vison*), and other predators (Ingles 1965, Knick 1984). Little is known of other mortality factors such as disease.

Aplodontia are not considered valuable game or fur animals today (Ingles 1965) although, in the past, Native American Indians wore robes made of mountain beaver and valued their meat (Herlocker 1950). The Indian robes, called "she-wal-lal," were the origin of the mountain beaver nickname, sewellel, which Lewis and Clark misunderstood to be the name of the animal (Godin 1964).

Fragility

There is no information on the Point Arena mountain beaver in captivity. Observations based on other subspecies provide conflicting reports on the species' fragility. Camp (1918) stated that *Aplodontia* are not hardy and do not live long if injured in the least. Pfeiffer (1953), noted that some animals recovered from injury and even from biopsies of parts of the reproductive system. Captured animals in the Pacific Northwest have a high trap mortality (Dodge and Campbell 1965, Lovejoy and Black 1979) and mountain beaver are known to succumb unexpectedly in captivity (Kindschy and Larrison 1961, Steele, pers. obs.). Others report that mountain beaver are easy to maintain in captivity for long periods of time (Fisler 1965, Davis 1941).

The sensitivity of mountain beaver to disturbance is not well known. Although most burrow openings are in isolated areas or under dense vegetation or on steep slopes, a population of *Aplodontia rufa nigra* has coexisted for since at least 1981 with campers in the Manchester State Beach campground (Steele, pers. obs.). Scheffer (1929) reported that animals stuck to their burrows despite clearing of vegetation, nearby blasting, burning of log and brush piles, and obstruction of burrow openings. Similar observations were made by Campbell *et al.* (1988), but these studies were in Washington State where mountain beaver are abundant. The effect of even slight disturbance on a small population could be highly detrimental, since recolonization might not be possible. Some Point Arena mountain beaver burrow systems have apparently remained unoccupied for a years (Steele, pers. obs.).

Pest Control

The California subspecies of mountain beaver are generally found in low numbers in isolated areas. However, in other portions of its range, especially in Washington and Oregon, mountain beaver are thriving and considered pests because of damage inflicted on commercial Douglas-fir plantations (Martin 1971, Maser *et al.* 1981, Smurthwaite 1986). The Point Arena subspecies is not known to cause problems beyond some minor garden pilfering and burrows in unwanted places.

E. REASONS FOR LISTING AND THREATS TO SURVIVAL

Overview

The vulnerability of the Point Arena mountain beaver result from two basic facts: 1) this subspecies has few populations with an extremely limited distribution; and, 2) the number of individuals in the populations are low. Add to this its low reproductive rate, and any catastrophe, whether natural or human-caused, has a high potential to severely impact the subspecies. Proposed gravel quarries, planned timber harvests, transportation and utility corridors, maintenance of flood control structures, new home construction, increased human disturbance, illegal destruction of streambed habitat, further fragmentation of habitat, and wildfires all pose some degree of direct or indirect threat to Point Arena mountain beaver at various locations. No estimates exist for the total habitat once available for the Point Arena mountain beaver, but it is likely that substantial habitat loss has occurred, given the amount of land that has been altered for urban development, agricultural uses, and timber production.

All historic Point Arena mountain beaver populations were located near farming or ranching activities. Livestock production, dating from the time of introduction of cattle by the Spanish, may well have substantially modified historical *Aplodontia* habitats both by grazing and brush clearing which have eliminated much coastal scrub habitat in the area (Steele 1986). Moreover, cattle have stepped on *Aplodontia* burrows and destroyed runways (D. Steele, pers. obs.). Many extant populations are found near agricultural or ranch land and are continue to be impacted by these activities (Steele 1986).

New home construction and associated activities at Irish Beach and along Irish Creek upslope from the mountain beaver population at this site have affected the habitat quality. Habitat loss, trash dumping, and an increase in predation by feral and nonferal house pets may have reduced the mountain beaver population at Irish Creek. Construction of private and county roads has also resulted in habitat loss. A planned development of 1,091 homes is in progress at Irish Creek. Ancillary facilities, including a market, motel, and offices, also are planned for construction. Part of this project includes the construction of a water diversion system at Mallo Creek to supply the domestic water needs of the development. Recently the California Coastal Commission approved the withdrawal of up to 50 cubic feet per second of water from Mallo Creek for residential use at the Irish Beach subdivision. This water diversion has the potential to adversely affect the mountain beaver by reducing the amount and quality of available habitat. The latest revision to the Mendocino County Land Use Plan shows additional housing developments, creating a potential for additional indirect and direct disturbance to the mountain beaver in the Irish Creek area.

The Irish Beach-to-Manchester Alternative Coastal Trail has been proposed to provide non-vehicular beach access at Irish Beach, Alder Creek Beach Road, Kinney Road, and Stoneboro Road. This project includes construction of a parking area, an interpretive center, and access to the proposed trail at both Irish Creek and Alder Creek. This would increase human disturbance to a mountain beaver population and reduce habitat quality. No information exists on how the Point Arena mountain beaver would react to such human disturbance. However, even a limited reduction in reproductive success or increase in mortality rates from predation could impact several small populations.

It is likely that there has been habitat loss from sheep and cattle grazing at the present American Telegraph & Telephone Company (AT&T) communications facility and as a result of construction and secondary impacts from use of the facility. It is not known how large this population was prior to construction of the communication facility, but the present population of about 20 animals continues to be impacted by pedestrians and occasional project activities.

Accidents and intentional acts around local creeks have the potential of disturbing or extirpating populations. Recent fiber optics projects have drilled under the Point Arena mountain beaver populations and caused noise, vibration, and some physical impacts to the habitat. The significance of these actions is not known and needs further monitoring. Also, illegal destruction of streambed habitat continues to occur on a regular basis (E. Ramos, California Department of Fish and Game, Yountville, pers. comm.). In some cases, streambed destruction has included destruction of mountain beaver habitat or potential habitat by such activities as heavy equipment operation, vegetation cutting, and/or vegetation burning. Reports from landowners and the public, and members of

"Friends of the River," personal observations (D. Steele), and examples found in various personal and FWS notes and files also verify this.

Both human- and natural-caused fires can be extremely detrimental to the Point Arena mountain beaver. For example, a human-caused fire at the Point Reyes National Seashore in October 1995, resulted in less than 1 percent survival of the original population of about 2,000 Point Reyes mountain beavers within the burn zone (G. Fellers, Point Reyes National Seashore, pers. comm.). The burned area encompassed about 40 percent of the range of this subspecies of the mountain beaver and included some of the most optimal habitat (U.S. Department of the Interior Burned Area Emergency Rehabilitation (BAER) Team 1995). Some of this prime habitat was *Baccharis* thickets, a habitat important for food and cover.

Overutilization

Overutilization is not known to be a problem with the Point Arena mountain beaver. However, the low number of individuals and site isolation make each population highly vulnerable to extirpation from collection for scientific or other purposes.

Disease or Predation

Little is known regarding diseases of mountain beaver. Animals in captivity have succumbed to infection and intestinal disease. Mountain beaver are known to harbor tapeworms and other parasites (Canaris and Bowers 1992).

Mountain beaver are preyed upon by most predators of small mammals including coyotes, skunks, owls, weasels, raptors, etc. Sign of predation by bobcat on Point Arena mountain beaver has been reported (T. Wooster, CDFG, pers. comm.) as well as raptor predation (D. Steele, pers. obs.). Domestic and feral dogs and cats also kill Point Arena mountain beaver, particularly in sites located adjacent to urban and agricultural developments such as those at Irish Gulch, Alder Creek, and Point Arena. This is supported by the discovery of a Point Arena mountain beaver killed by a domestic dog (K. Joe, CDPR, pers. comm.). The impact of predation on small populations has the potential to become critical.

Other Natural and Human Factors Affecting Continued Existence

Road construction roads may reduce or eliminate the ability of young Point Arena mountain beaver to disperse successfully from natal areas. Two observations of mountain beaver killed crossing Highway 1 have been made, at Gasker Slough bridge and Kinney Road (K. Joe, pers. comm., D. Steele, pers. obs.). Populations at Minor Hole Road, Alder Creek, Manchester Beach, and Irish Beach have burrows near roadways (Steele 1986), increasing the likelihood that mountain beaver will wander onto the pavement. The nocturnal habits of the animal make road crossing even more hazardous

Pest control is an on-going threat to *A. r. nigra*. Earlier, an intensive gopher control program in western Mendocino County may have impacted Point Arena mountain beaver. Maintenance workers at the KOA campground near Manchester State Beach placed poison bait and traps out to kill mountain beaver they mistakenly thought to be gophers. Rodent trapping and baiting, often associated with residences and gardens, is still common along the Mendocino Coast (Steele 1986). Baits laced with strychnine or anticoagulants are the most widely used (Steele 1986). Other damaging chemicals, to which mountain beaver may be exposed, include copper sulfate, which is sometimes applied to wet spots and seeps to control sheep liver fluke (Steele 1986), and herbicides, which are regularly sprayed on vegetation near mountain beaver populations. No information is available assessing the impacts of such activities on the Point Arena mountain beaver. Any mountain beaver that may have succumbed to chemical poisoning would likely have died unobserved within the burrow. The small, isolated populations of the Point Arena mountain beaver are potentially highly vulnerable to extirpation from lethal chemicals.

Several alien plants occur in Point Arena mountain beaver habitat including gorse *(Ulex europaeus)*, broom *(Cytisus* sp.), pampas grass *(Cortaderia selloana)*, German ivy *(Senecio mikanioides)*, ice plant (*Mesembryanthemum* sp), and European beach grass (*Ammophila arenaria)*. In some areas these species are established and relatively widespread, and may reduce or improve the quality and quantity of Point Arena mountain beaver habitat. For example, German ivy is known to be a problem in some areas and spreading, but more survey work is needed to determine the extent of detrimental effects. No specific impacts to occupied habitat have been documented but are likely (D. Steele, pers. comm.). German ivy favors shady and disturbed areas, and is renowned for invading riparian areas. Native to South Africa, it is generally found below 180 m (600 ft) (K. Fuller, FWS, pers. comm.).

Ice plant is slowly spreading in some older dune areas. Observations of many mountain beaver burrows at Point Arena revealed partially eaten pieces of ice plants (K. Fitts, in press), which apparently provide the mountain beaver with a year-around food source that is high in water content. Much mountain beaver habitat at Point Arena contains no standing water for most of the year. Where ice plant exists, the only available free water comes from ephemeral puddles that form during rainstorms. Ice plant may also be beneficial in that its root structure may stabilize sandy soil through which the mountain beaver burrows (K. Fitts, in press).

European beachgrass has displaced native vegetation at the AT&T population site (in Mendocino County) and at Manchester State Beach. There are burrows at the edge of the habitat, but no signs of foraging (D. Steele, pers. comm.). European beachgrass is found at several burrows in the Point Arena area. Many of the burrows are located underneath the plants, and runways are found under large clumps of dead beachgrass. Its root system is an important soil stabilizer, and the canopy provides cover (K. Fitts, in press).

The importance of alien species, such as ice plant and European beachgrass, to the Point Arena mountain beaver is not fully known. Further studies should be undertaken to assess their significance, and careful consideration should be given to the effects of their management on the mountain beaver (K. Fitts, in press).

Because Point Arena mountain beaver have a localized distribution, they are extremely vulnerable to catastrophic events such as storms, fire, flooding, disease, drought, or earthquake. Winter storms recently undercut dunes at Manchester State Beach. The area affected was very close to Point Arena mountain beaver burrows and may have destroyed several. Point Arena was hard hit during the 1906 earthquake and mountain beaver populations are situated on the fault line. Such natural disasters could easily eliminate all individuals in a population or further depress already low population numbers to a point where they could not recover. The threat of catastrophic fire should be given special consideration based on recent events. There has been at least one fire very near occupied Point Arena mountain beaver habitat in the last five years (D. Steele, pers. obs.). Less than 1 percent of a population of the subspecies of mountain beaver at Point Reyes survived a recent large fire (G. Fellers, Point Reyes National Seashore, pers. comm.).

Point Arena mountain beaver population numbers may be so low that the effects of inbreeding among closely-related individuals could result in an increase in deleterious genes in the population. Individuals possessing such deleterious genes are less likely to be capable of adapting to environmental changes, even relatively minor ones. Moreover, small populations are subject to the effects of genetic drift, the random decline in genetic variation that can occur in small populations. This too limits the flexibility of a population to respond to environmental changes. The effects of genetic drift and inbreeding depression are genetically similar. Individual populations of Point Arena mountain beaver number from about 3 to 20+ animals and, therefore, the genetic effects of small size are likely to be a significant factor in the taxon's long-term survivability.

Habitat fragmentation is a major concern as it can increase the genetic isolation among populations of mountain beaver. Subdivision of habitat into smaller blocks results from human-related activities such as fire, water diversion, livestock grazing, road construction, and urban development. Habitat fragmentation can reduce population size, thereby increasing the probability of genetic drift and inbreeding depression. This may result in less viable and adaptable populations of mountain beaver.

F. CONSERVATION MEASURES

Most of the measures to protect Point Arena mountain beaver are in the initial stages. The following efforts are currently either in place or underway:

IN PLACE:

o Listing the Point Arena mountain beaver as a federally endangered species has given the subspecies a certain amount of protection.

- Timber Harvest Plans must determine the presence or absence of Point Arena mountain beaver and take steps to avoid disturbance, if present. Section C (Biological Resources) of Appendix-Technical Rule Addendum No. 2 in "California Forest Practice Rules, Title 14, California Code of Regulations" states that: "Biological assessment areas will vary with the species being evaluated and its habitat. Factors to consider in the evaluation of cumulative biological impacts include: 1. Any known rare, threatened, or endangered species or species of special concern . . . that may be directly or indirectly affected by project activities...". Section 1034 describes the requirement of the contents of the proposed Timber Harvest Plan, including "information on the presence and protection of known habitat or individuals of any listed species which may be significantly impacted by the timber operation."

- The CDFG's California Natural Diversity Database (CNDDB) lists known populations of the Point Arena mountain beaver and provides this information for planning purposes.

UNDERWAY:

- Due to the federal listing, planning decisions must take possible threats to the mountain beaver into consideration.

- The AT&T Corporation is in the process of acquiring a conservation easement (Levine property - see Table 2) as part of mitigation for the bentonite spill of 1992. Details of this are not yet known.

- A five-year study to monitor Point Arena mountain beaver as part of the mitigation for an MCI microwave tower is entering its fifth year (Northern and Fitts 1993, 1994, 1995, and 1996). In this study, burrows are being monitored along transects on the impacted site as well as two control sites, and data on vegetation are also being collected. Construction of the MCI facility caused a decrease in the number and areal extent of active burrows, but there has been a gradual recovery since 1993 (Northern and Fitts 1995).

II. Recovery

A. OBJECTIVE AND CRITERIA

The objective of this recovery plan is to ensure the long-term survivability of the Point Arena mountain beaver. Detailed information remains lacking concerning the biology, habitat requirements, distribution, etc., of the Point Arena mountain beaver. The recovery criteria for downlisting and delisting, therefore, reflect the best biological knowledge and assumptions regarding the species. These reclassification criteria should be considered preliminary and may be revised on the basis as new data become available.

Downlisting criteria:

1. At least 16 populations including, if possible, existing populations at Alder Creek, Irish Creek, Mallo Pass Creek, Hathaway Creek (north), and the Garcia River tributaries, are protected from disturbance in perpetuity. Each population shall contain at least 12 ha or more of occupied habitat that is protected.

2. A combined total of at least 320 ha (790 ac) of habitat is protected within at least 16 populations. These populations shall have a mean density of at least seven Point Arena mountain beavers per ha (17/ac) of occupied habitat.

3. All 16 populations are stable (i.e., no more than a 25 percent change in estimated population size from highest to lowest value) or increasing for a period of 12 years (following attainment of #1), as documented through establishment and implementation of a scientifically acceptable population monitoring program.

4. The amount of additional habitat needed for population interconnectivity, travel corridors, and dispersal habitat has been determined.

5. Sufficient information is available to permit adaptive management, and any management actions necessary to ensure the continued success of these populations (in #1) have been fully implemented.

Delisting criteria:

1. At least 32 populations including, if possible, existing populations at Alder Creek, Irish Creek, Mallo Pass Creek, Hathaway Creek (north), and the Garcia River tributaries, are protected from disturbance in perpetuity. Each population shall contain at least 16 ha or more of occupied habitat that is protected.

2. A combined total of at least 640 ha (1,581 ac) of habitat is protected within at least 32 populations. These populations shall have a mean density of at least seven Point Arena mountain beavers per ha (17/ac) of occupied habitat.

3. Population monitoring after the 12 year period shows a trend of stable (i.e., no more than a 25 percent change in estimated population size from highest to lowest value) or increasing population size for a period of 10 years.

4. The additional habitat needed for population interconnectivity, travel corridors, and dispersal habitat has been protected and is being managed appropriately.

5. Adaptive management prescriptions have been determined and implemented for all populations.

The estimated date for downlisting to threatened status is 2015 and delisting is by 2025.

The goals and objectives stated here are subject to change as more information becomes available on the Point Arena mountain beaver through the work undertaken in this recovery effort, and as advances are made in the field of conservation biology and in our understanding of endangered species.

B. STEPDOWN NARRATIVE

1.0 Evaluate and protect known mountain beaver populations

Point Arena mountain beaver have been found in 24 isolated locations. Long-term habitat protection is vital for the protection of Point Arena mountain beaver populations. Most of the threats to the animal are a result of habitat destruction and degradation. All known populations must be protected from the threats identified in Section I.E. (with special consideration for unusual habitats). The populations should be evaluated and protection priorities assigned based on specified criteria.

1.1 Evaluate known populations and identify land parcels for protection

The priorities for land acquisition or easement should be based on those areas with large mountain beaver populations, degree of threats to habitat, and willing landowners. It may be advantageous to look at areas that would benefit several species of special concern at once.

1.2 Protect populations through land purchase, easements, or other mechanisms

High priority land parcels identified in Task 1.11 should be protected through purchase, gift, conservation easement or other methods.

1.21 Protect the Leonard parcel inholding at Manchester State Park

One of the largest mountain beaver populations occurs within Manchester State Park and the Leonard parcel inholding. In addition to mountain beavers, the Leonard parcel may also provide habitat for yellow-legged frogs, tidewater goby, swamp harebell and the rare Mendocino Coast Indian paintbrush. Caltrans, CDPR, CDFG, and FWS should work together to protect this parcel. The owner of the parcel has been contacted regarding possible acquisition.

1.22 Protect other land parcels with known habitat

Protect high priority habitats identified in Task 1.1.

2.0 Identify, evaluate, and protect suitable habitat, buffers, and corridors

Potential, but currently unoccupied, habitat may be a necessary reservoir for mountain beaver to ensure population structure and dynamics (Todd 1990). It may therefore be necessary to protect not only habitat currently occupied by mountain beaver but also suitable areas to which animals can disperse, as well as buffers for occupied and suitable habitat, and corridors to allow movement and genetic exchange among populations. Room for expansion is also necessary if population sizes are to increase. As more information becomes available on the distribution and habitat requirements of Point Arena mountain beaver (Tasks 5.1, 7.7, it is expected that more corridors and potential habitat will be identified.

2.1 Identify potential habitat, buffers, and corridors

The historic and potential range limits of Point Arena mountain beaver should be surveyed for potential habitat using the latest aerial mapping techniques to identify vegetation types known to provide potential habitat. This mapping will help identify buffers and corridors to existing populations and/or areas that may need special management consideration. This will also provide better data on the extent of potential habitat and important information to use in surveying for new populations (Task 5.1).

2.2 Evaluate suitability of potential habitat, buffers, and corridors

Potential habitat is necessarily suitable habitat for the mountain beaver. The suitability of all potential habitat identified must be assessed. The optimal size, location, and configuration of buffers must also be evaluated and priorities for further land protection assigned based on these criteria.

2.3 Protect suitable habitat, buffers, and corridors

Important habitat buffers, corridors, and other suitable habitat should be protected and through purchase, gift, conservation easement or other appropriate mechanisms. For example, fencing or some other method of exclusion may in some cases be sufficient to protect habitat.

3.0 Enhance, restore, monitor, and manage protected habitat, buffers, and corridors

Enhancement or restoration can increase the suitability of habitat for Point Arena mountain beaver. This may be most important along degraded corridors between populations or buffer habitat adjacent to existing populations. Guidelines for enhancement and restoration of habitat should be determined using data gathered in Task 7.7. Enhanced or restored habitat should be monitored to assure that clearly identified standards of success are met. The results of monitoring studies should be used to identify adaptive management strategies to further enhancement and restoration goals and objectives.

3.1 Evaluate and identify protected sites for enhancement and restoration

Priorities should include population corridors, buffer habitat adjacent to existing populations, and degraded mountain beaver habitat with a high degree of potential for success.

3.2 Develop and implement site-specific restoration strategies

A strategic plan should be developed for each restoration site outlining procedures, site treatments, plant species selections, costs, timeline, and success criteria. This plan should be implemented at each restoration site.

3.3 Develop and implement monitoring plans and adaptive management strategies

Restoration sites must be monitored for a period of time to be determined under Task 7.2. Monitoring techniques should be designed to contribute to our knowledge of the habitat requirements of Point Arena mountain beaver. Techniques should be selected from existing mitigation guidance, expert input, and comparison with conditions at other representative population and reference sites. Sampling methodologies should be clearly defined. Goals and success criteria should be developed for, but not necessarily limited to, biological factors such as species composition, survivorship, plant height, plant vigor and health, percent vegetative cover, natural and reproduction and recruitment, and any physical factors found to be representative of Point Arena mountain beaver habitat. The frequency and duration of this monitoring should be based on the same approach described above.

Contingency plans should be developed to guide remedial actions in the event success criteria are not met. An adaptive management plan should be developed and implemented, if necessary, based on the results of the monitoring. Population trends of the mountain beaver, if present, at restoration sites should also be monitored.

4.0 Develop management guidelines to protect Point Arena mountain beaver

Sound management is a key component in the protection of Point Arena mountain beaver. Guidelines that anticipate and respond to possible threats to the subspecies must be implemented. These guidelines should be based on the best available knowledge of the Point Arena mountain beaver and should be revised as studies provide more information.

4.1 Develop comprehensive management guidelines

Guidelines should be developed to include specific policies for managing existing populations of the mountain beaver. These policies should address identified threats to the species such as predation by domestic and feral dogs and cats. Vegetation management and exotic plant control should also be addressed. A section for private landowners with mountain beaver populations on their property should cover pesticide use, domestic animals, protective measures, etc. A section on emergency response for contingencies such as fire and other natural and human-caused disasters should also be included. Implementation and enforcement should also be covered. These guidelines should be revised regularly as more information becomes available on the Point Arena mountain beaver.

These guidelines, or the appropriate sections, should be publicized and made available to agencies and individuals including the County of Mendocino, CDFG, CDPR, Caltrans, Department of Forestry, Coastal Commission, local fire departments, timber industry, City of Point Arena, Manchester/Point Arena Indian Rancheria, and local citizens.

4.2 Develop management plan for Parks and Recreation lands with mountain beaver habitat

The CDPR is one of the largest landowners of Point Arena mountain beaver occupied habitat. A comprehensive management plan to protect mountain beaver, with guidelines and policies for these areas, needs to be developed and adopted by CDPR.

4.3 Develop management guidelines for mountain beaver habitat within the City of Point Arena

A significant number of Point Arena mountain beaver are found within the jurisdiction of the City of Point Arena. The City should develop a management plan with guidelines and policy for Point Arena mountain beaver. This could take the form of a habitat protection ordinance.

5.0 Determine and monitor population numbers and distribution

A better understanding of population numbers and distribution, will give a fuller picture of population viability and threats to Point Arena mountain beaver. These numbers, are necessary to assess the subspecies' status over time. The Point Arena mountain beaver is found over a very limited range. Studies to document the limits of this distribution and the reasons for it are needed. Techniques for these studies should be evaluated and developed (Task 7.2). The GIS map developed in 5.2 and results from 2.0 will be helpful in accomplishing this.

5.1 Survey potential habitat to locate new populations

Much of the potential mountain beaver habitat is on private land or in inaccessible areas. However, gaining access to some of these spots is essential to accomplishing this task. New populations found beyond the current known range would be particularly significant discoveries.

5.11 Survey along drainages for limits of Point Arena mountain beaver

The Garcia River, and other drainages, should be surveyed inland to find out if any populations of Point Arena mountain beaver exist in stretches further east than currently documented. Permission should be solicited from the Chairperson of the Point Arena Indian Rancheria to survey areas of potential habitat.

5.12 Survey other potential habitat for new populations

New populations have been found in the last two years in areas identified as potential habitat. New populations may be discovered through additional surveys in these areas and possibly other areas considered potential habitat through information gathered in Tasks 2.0 and 7.7.

5.2 Update the California Natural Diversity Data Base (CNDDB)

When making planning decisions, state and local agencies and private entities rely on data from the CNDDB to identify areas that may contain Point Arena mountain beaver. Agencies and individuals do not always send new population findings to the CNDDB, resulting in planning decisions based on outdated or insufficient information in regards to Point Arena mountain beaver. To maintain a current and accurate database, all new population information should be sent to the CNDDB for updating.

5.3 Develop map of entire range distribution

Mapping using a Geographic Information System (GIS) would help identify, prioritize and manage Point Arena mountain beaver habitat. Each known population should be surveyed using Global Positioning Station (GPS) equipment to determine the precise location and extent of burrow systems. These data could be combined with data on to quantify population sizes, habitat, land use, and other factors to accurately map the distribution of the animal. Mapping may also help define a population as it relates to groups of burrow systems. This term has been loosely applied to isolated burrows, some of which likely have only one or two animals. Some populations may actually be part of larger metapopulations. Using information gained through mapping, along with genetic analysis (Task 7.6), it should be possible to better define the population structure of Point Arena mountain beaver.

6.0 Develop and implement monitoring plan for Point Arena mountain beaver populations

All known populations should be monitored to determine population trends, habitat changes and help identify threats to populations. To use available time and funding most effectively, this monitoring should be both qualitative and quantitative, with all populations being assessed qualitatively and only selected populations surveyed using more quantitative techniques. Results of these surveys should be sent in a timely manner to the CNDDB.

6.1. Developing protocols for qualitative and quantitative monitoring

Protocols for the collection and analysis of qualitative and quantitative monitoring data should be developed using information from Task 7.2.

6.2 Conduct qualitative assessments of all known populations

Each population should be monitored to determine its status. Parameters to be noted include presence/absence of burrows, activity (digging, clipping, debris, cobwebs, etc.), habitat modification, disturbance, or threats, and other factors using protocols developed under Task 6.1. Surveys should be undertaken at the same time of year, preferably in the spring or summer.

6.3 Conduct quantitative surveys of representative populations

Representative populations will be chosen to be monitored in greater detail, using protocols identified under Task 6.1 and techniques developed in Task 7.3.

7.0 Conduct essential research on Point Arena mountain beaver

Little information exists on the biology or ecology of the Point Arena mountain beaver. Even anecdotal observations are scarce. Most of our knowledge and assumptions are based on studies of other, more abundant, subspecies of mountain beaver. To make informed management decisions (i.e., applying adaptive management, which means conducting essential research, analyzing the results, and revising management accordingly), it is imperative to learn more about the Point Arena mountain beaver. Researchers who have been studying mountain beaver in Washington state have expressed interest in sharing information and may be able to provide helpful insights and techniques for use with the Point Arena subspecies.

7.1 Establish a library of literature on mountain beaver

A comprehensive library of mountain beaver and related literature, should be gathered and made available to researchers. This will save time and facilitate research because some of the literature is difficult to find. A literature search should be undertaken annually to keep the library current.

7.2 Design studies to gather biological/ecological data on Point Arena mountain beaver

When techniques are developed, design a study or series of studies to collect data on parameters. Some of the basic parameters that need to be determined include: density, dispersal habitat, travel corridors, population interconnectivity, age structure, litter size, longevity, and sex ratio.

7.3 Develop safe and accurate monitoring techniques

Because mountain beaver spend most of their time underground, it is difficult to gather certain data without capturing animals. Indirect study methods should be used whenever feasible. Much of the research on mountain beaver has been accomplished through sacrificing animals. New techniques will need to be developed for handling animals with the minimum disturbance and risk. A review of the literature to find successful surveying techniques used with similar animals would supplement this effort. All techniques must be perfected using other subspecies of mountain beaver before being attempted on Point Arena mountain beaver. The Point Reyes mountain beaver is most similar to the Point Arena mountain beaver, and, therefore, would be the subspecies of choice for this work. The October 1995 fire at Point Reyes National Seashore resulted in the monitoring of the surviving Point Reyes mountain beaver population. Monitoring there involves transect surveys of burrows to determine the beaver's survival and distribution within the burn area, and "automated" monitoring of burrows to determine short-term survival, reproductive success, and habitat suitability (BAER Team 1995). Many of these techniques could be used for the Point Arena mountain beaver.

Monitoring of the Point Arena mountain beaver is also being done for the MCI Telecommunications Corporation. MCI installed a microwave tower on AT&T's communication facility at Manchester Beach State Park in Mendocino County, which contains active Point Arena mountain beaver habitat. Method descriptions can be found in years 1-4 reports (P.T. Northen *et al.* 1993, 1994, 1995, 1996). These methods may be suitable for use in future Point Arena mountain beaver monitoring activities.

7.31 Develop indirect monitoring techniques

Indirect techniques, including cameras, smoke plates, microphones, activity counters, trip wires, hair traps and others, are preferable since they involve the least disturbance to the animals. These techniques need to be evaluated to determine which are most effective.

7.32 Develop safe live trapping/handling techniques

Mountain beaver are known to suffer from high trap mortality, at least in the Pacific Northwest (Dodge and Campbell 1965). Methods to minimize danger to the animal (and to the handler) must be perfected using other subspecies, prior to conducting any extensive live-trapping on the Point Arena mountain beaver.

7.33 Develop and implement safe radiotelemetry techniques

Certain types of information, such as movement and dispersal activity, and home range, can only be gathered by following individuals through time. Radiotelemetry is an effective way of doing this. This technique should be adapted to Point Arena mountain beaver, again being perfected on a more abundant subspecies.

7.4 Study effects of scent on population establishment and dispersal

Pheromone analysis may help determine whether chemical cues are causing Point Arena mountain beaver to cluster and occupy some habitat and not to occupy other seemingly appropriate habitat.

7.5 Study effects of disturbance

The Point Arena mountain beaver's sensitivity to disturbance is largely unknown. There have been several recent questions about disturbances of various kinds and the appropriate buffer zones needed to protect animals. More work needs to be done in these areas. Disturbance needs to be evaluated, including the effects of electromagnetic fields, noise, vibration, toxics, microwaves, and habitat modification, including invasion of exotic plants such as German ivy, ice plant, and European beach grass. Results of this task should be used to update the comprehensive guidelines prepared in Task 4.1.

7.6 Conduct genetic analyses

It is generally accepted that Point Arena mountain beaver has been geographically isolated from other subspecies for a long time, but the length and degree of genetic isolation are unknown. Insights could be provided through genetic analysis and comparison with other subspecies. It may be that full species status is more appropriate, as originally believed by Taylor (1914). This task is not considered to be of sufficient priority to warrant sacrificing animals. Material appropriate for genetic analysis should be salvaged, as appropriate, from animals that have died due to other causes, according to the necropsy/salvage protocol developed in Task 3.9. Also, hair and blood could be collected from live animals.

7.7 Determine habitat requirements for Point Arena mountain beaver

There is little quantitative information on the habitat requirements of Point Arena mountain beaver. Populations have been found in a variety of habitat types, but basic limiting factors are not known. This information is necessary for management purposes and possible habitat restoration work.

Data should be collected on the following habitat parameters: vegetation associations and cover values, soil characteristics, slope/aspect, microclimate, hydrology, etc. Studies should be done on the spectrum of mountain beaver habitats. Historic aerial photos can be used to compare previous vegetation, and land uses with current habitat use

The duration and methodologies of this research should be determined under Task 7 2 It may be best to collect data over a longer period of time if unusual conditions such as drought occur

7 8 Study food habits

While it is known that Point Arena mountain beaver utilize many, if not most, of the plant species in their vicinity, there is little information on which plants are most important in their diet A fecal analysis study could help to determine the important food plants Fecal material should be gathered over time, as food preferences may change throughout the year Stomach contents from fresh carcasses can also be analyzed, according to the protocol developed in Task 7 9

7 9 Develop protocol for necropsies on any acquired carcass

A protocol must be developed for treating animals found dead, to maximize the information available on the Point Arena mountain beaver This protocol should include procedures for handling dead animals, salvaging and storing parts for further study, identifying the responsible party, data collection and analysis, necropsy procedures, museum or other repository consignment, and the reporting of the results

7.10 Gather demographic information relevant to population viability analysis (PVA)

When techniques are developed, design a study or series of studies to collect data on parameters necessary to conducting a PVA. Some of the basic parameters that need to be determined include: density, dispersal, age structure, litter size, longevity, and sex ratio.

7.11 Conduct PVA and assess criteria for downlisting/delisting and population stability

Conduct a PVA assessment using information gathered from Tasks 7.10 nd 6.0. The PVA results should be used to assess the adequacy of the criteria for downlisting, delisting, and population stability.

8.0 Assess potential of relocation to establish new populations and implement if feasible and necessary

The feasibility and necessity of relocating animals should be evaluated after basic information is gathered about Point Arena mountain beaver and its requirements. This may have potential as an important recovery strategy to reintroduce Point Arena mountain beavers throughout their historic range, possibly in conjunction with habitat restoration (Task 1.3). Reintroduction, however, should not be considered as a "cure-all" for mountain beaver populations that are "in the way" of development. It is a costly and labor-intensive undertaking and generally incurs high mortality of introduced animals. Relocation might receive moderate consideration for locations where existing land use practices, such as agriculture, lead to conflict with the Point Arena mountain beaver.

8.1 Determine feasibility and necessity of relocation

The feasibility and necessity of relocation should be assessed based on all available information.

8.2 Develop relocation protocols and conduct relocations, if feasible and necessary

If relocation is deemed appropriate and necessary, a plan should be developed that identifies potential habitat for relocation activities, appropriate animals to be relocated (e.g., dispersing juveniles), and practical/technical aspects of the relocation project. Relocations would likely be conducted over several years.

9.0 Develop and implement monitoring and management plans for relocated populations

9.1 Develop and implement monitoring plans for newly established populations

Monitoring should continue for an appropriate length of time to determine the success of the relocation effort.

9.2 Develop and implement adaptive management, as needed

Relocation should success should be based on explicit criteria and a contingency plan should be developed for use in the event that the success criteria are not met. The contingency plan should be flexible so that accepted principles of adaptive managment may be followed.

10.0 Establish an outreach program

The best way to enlist the long-term support of area residents and others is to inform them of the benefits and importance of biological diversity and the Point

Arena mountain beaver in particular. This could be accomplished in conjunction with an outreach program on all the local threatened and endangered species.

10.1 Designate a coordinator of the outreach effort

A part-time person can develop and coordinate an outreach program that will require gathering and producing materials, contacting appropriate venues for disseminating information, and presenting programs. Volunteers could be trained to do many of the presentations. Age-appropriate school presentations should be developed for all grade levels. Also, press releases should be distributed to the media periodically to keep this issue in the public eye.

10.2 Produce outreach materials

A comprehensive outreach program could include the following materials.

- A booklet for adults that presents information on the biological importance of the Point Arena mountain beaver and possibly on other local species of concern.

- A separate brochure to inform landowners of resources available to them and steps they can take to protect mountain beaver on their land.

- An activity/educational book for children, geared for ages 6–12. This booklet could be disseminated through schools, at Manchester State Beach, through agency offices, etc.

- Other interpretive materials, such as models, are an important part of any outreach effort. The possibility of a permanent display should be explored.

- Periodic press releases on the recovery effort for dissemination to the media.

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III. Implementation Schedule

The Implementation Schedule that follows outlines actions and estimated costs for the recovery program of *Aplodontia rufa nigra*. It is a guide for meeting the objectives discussed in Part II of this Plan. This schedule indicates task priorities, task numbers, task descriptions, duration of tasks, the responsible agencies, and lastly, estimated costs. These actions, when accomplished, should bring about the recovery of the species and protect its habitat. Cost estimates provided here are intended as gross estimates for general planning purposes. More detailed budget analyses will be necessary by the responsible agencies.

Definition of Priorities

Priority 1 An action that ***must*** be taken to prevent extinction or to prevent the species from declining irreversibly in the ***foreseeable*** future.

Priority 2 An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

Priority 3 All other actions necessary to meet the recovery objectives.

Acronyms and Abbreviations

NDDB — Natural Diversity Database (California Department of Fish and Game)

CDFG — California Department of Fish and Game

CDPR — California Department of Parks and Recreation

FWS — Fish and Wildlife Service

TBD — To Be Determined

Recovery Implementation Schedule for the Point Arena Mountain Beaver

Priority	Task #	Task Description	Duration (Yrs)	Responsible Party	Total Cost	Costs in $1,000										Comments
						FY1	FY2	FY3	FY4	FY5	FY6	FY7	FY8	FY9	FY10	
1	1.1	Identify parcels	1	FWS	0.0	0.0										
1	1.21	Protect CDPR inholding	1	FWS, CDFG, CDPR	40.0	40.0										
1	1.22	Protect other parcels	5	FWS	500.0		100.0	100.0	100.0	100.0	100.0					
1	2.1	Identify potential habitat	continuous	FWS	0.0		0.0	0.0	0.0	0.0						
1	2.2	Identify suitable habitat	continuous	FWS	0.0		0.0	0.0	0.0	0.0						
1	2.3	Protect buffers, corridors and suitable habitat	3	FWS	TBD				TBD	TBD	TBD					
2	3.1	Identify habitat for restoration	continuous	FWS	0.0				0.0							
2	3.2	Develop and implement site-specific restoration strategies	1	FWS	TBD				TBD							
2	3.3	Monitor restoration	continuous	FWS	20.0					4.0	4.0	4.0	4.0	4.0		
2	4.1	Develop comprehensive guidelines	1	FWS	5.0	5.0										
2	4.2	Develop CDPR management plan	1	CDPR	20.0	20.0										

Recovery Implementation Schedule for the Point Arena Mountain Beaver

Priority	Task #	Task Description	Duration (Yrs)	Responsible Party	Total Cost	Costs in $1,000										Comments
						FY1[1]	FY2	FY3	FY4	FY5	FY6	FY7	FY8	FY9	FY10	
2	4.3	Develop management guidelines for City of Point Arena	1	City of Point Arena	15.0	15.0										
2	4.4	Develop other site-specifc plans	as needed	TBD	TBD	TBD										
2	5.11	Survey potential habitat along drainages	3	FWS	15.0	5.0	5.0	5.0								
2	5.12	Survey other potential habitat	3	FWS	15.0	5.0	5.0	5.0								
3	5.2	Update CNDDB	continuous	CDFG	0.0	0.0	0.0	0.0								
3	5.3	Develop GIS map	continuous	FWS/CDFG	0.0	0.0	0.0	0.0								
2	6.1	Develop monitoring protocol	1	FWS/CDFG	0.0	0.0										
2	6.2	Qualitative monitoring of populations	continuous	FWS	25.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
2	6.3	Quantitative monitoring of populations	continuous	FWS	10.0	0.0	2.0	2.0	2.0	2.0	2.0					
3	7.1	Establish library	continuous	FWS	0.0	0.0										
2	7.2	Design studies to gather biological/ ecological data	2	FWS	TBD											

Recovery Implementation Schedule for the Point Arena Mountain Beaver

Priority	Task #	Task Description	Duration (Yrs)	Responsible Party	Total Cost	Costs in $1,000										Comments
						FY1[1]	FY2	FY3	FY4	FY5	FY6	FY7	FY8	FY9	FY10	
2	7.31	Develop indirect monitoring studies	4	FWS	50.0		20.0	10.0	10.0	10.0						
2	7.32	Develop live-trapping techniques	2	FWS	20.0		10.0	10.0								
2	7.33	Develop radiotelemetry studies	4	FWS	50.0			20.0	10.0	10.0	10.0					
2	7.4	Study effects of scent	2	FWS	TBD						TBD	TBD				
2	7.5	Study effects of disturbance	5	FWS	60.0		20.0	10.0	10.0	10.0	10.0					
3	7.6	Conduct genetic analyses	2	FWS	20.0		10.0	10.0								
2	7.7	Determine habitat requirements	continuous	FWS	TBD		TBD	TBD	TBD	TBD	TBD					
2	7.8	Study food habits	2	FWS	20.0						10.0	10.0				
3	7.9	Develop protocol for necropsies	1	FWS	0.0	0.0										
3	7.10	Gather demographic information relevant to pva	1	FWS	10.0		10.0									
3	7.11	Verify criteria for delisting and population stability	1	FWS	0.0						0.0					

Recovery Implementation Schedule for the Point Arena Mountain Beaver

Priority	Task #	Task Description	Duration (Yrs)	Responsible Party	Total Cost	Costs in $1,000										Comments
						FY1[1]	FY2	FY3	FY4	FY5	FY6	FY7	FY8	FY9	FY10	
3	8.1	Determine feasibility of relocation	1	FWS	0.0						0.0					
3	8.2	Plan and conduct relocations,	if feasible and needed	FWS	TBD						TBD					
3	9.1	Develop and implement monitoring plans	if necessary	FWS	TBD											
3	9.2	Develop and implement adaptive management	if necessary	FWS	TBD											
3	10.1	Designate outreach coordinator	2	FWS	0.0	0.0	0.0									
3	10.2	Produce outreach materials	1	FWS, CDPR	15.0	15.0										

[1] FY1 designates the first fiscal year following approval of the Recovery Plan

END

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